

Aromatic amine compounds their method of preparation and pharmaceutical compositions in which they are present

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Inventor(s): EDMONDS-ALT XAVIER (FR); PROIETTO VINCENZO (FR); VAN BROECK DIDIER (FR); GOULAOUIC PIERRE (FR)

Applicant(s):: SANOFI SA (FR)

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Abstract

Aromatic amine derivatives of the general formula (I)  (I) or salts of the derivatives with mineral or organic acids are useful as neurokinin receptor antagonists.

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Description

The present invention relates to novel aromatic derivatives substituted by an amino group and by various ester, amine or amide functional groups, and to their enantiomers.

The present invention further relates to the method of obtaining the compounds, which can be enantioselective, and to the use of the compounds according to the invention in compositions for therapeutic use and more particularly in pathological phenomena involving the neurokinin system, such as: pain (D. REGOLI et al., Life Sciences, 1987, 40, 109-117), allergy and inflammation (J. E. MORLAY et al., Life Sciences, 1987, 41, 527-544), circulatory insufficiency (J. LOSAY et al., 1977, Substance P, Von Euler, U.S. and Pernow ed., 287-293, Raven Press, New York), gastrointestinal disorders (D. REGOLI et al., Trends Pharmacol. Sci., 1985, 6, 481-484) and respiratory disorders (J. MIZRAHI et al., Pharmacology, 1982, 25, 39-50).

Ligands endogenous to neurokinin receptors have been described, such as substance P (SP), neurokinin A (NKA) (S. J. BAILEY et al., 1983, Substance P, P. Skrabank ed., 16-17 Boole Press, Dublin) and neurokinin B (NKB) (S. P. WATSON, Life Sciences, 1983, 25, 797-808).

Neurokinin receptors have been recognized on numerous preparations and are currently classed in three types: NK1, NK2 and NK3. Whereas the majority of the preparations studied hitherto have several types of receptors, such as guinea-pig ileum (NK1, NK2 and NK3), some of them are said to possess only one type, such as dog carotid artery (NK1), rabbit pulmonary artery devoid of endothelium (NK2) and rat portal vein (NK3) (D. REGOLI et al., Trends Pharmacol. Sci., 1988, 9, 290-295 and Pharmacology, 1989, 38, 1-15).

The recent synthesis of selective agonists has made it possible to characterize the various receptors more precisely. Thus [Sar@9, Met-(O2)@11]SP, [Nle@10]NKA4-10 and [MePhe@7]NKB are said to have a selectivity for the NK1, NK2 and NK3 receptors respectively (q.v. D. REGOLI, 1988 and 1989, cited above).

It has now been found that certain aromatic amine compounds possess valuable pharmacological properties as neurokinin receptor antagonists and are especially useful for the treatment of any substance P-dependent and neurokinin-dependent pathological condition.

Thus, according to one of its features, the present invention relates to aromatic amine derivatives of the formula in which m is 2 or 3.

Ar and Ar' independently are a thienyl group; a phenyl group which is unsubstituted or mono- or di-substituted by a halogen atom, preferably a chlorine or fluorine atom, by a C1-C3 alkyl, by a trifluoromethyl, by an alkoxy in which the alkyl is C1-C3, by a hydroxyl or by a methylenedioxy; or an imidazolyl group; it also being possible for Ar' to be a benzothienyl group which is unsubstituted or substituted by a halogen, preferably by a chlorine or fluorine atom; a naphthyl group which is unsubstituted or substituted by a halogen, preferably by a fluorine atom; a biphenyl group; or an indolyl which is unsubstituted or substituted on the nitrogen by a benzyl group;

X is hydrogen;

X' is hydrogen or a hydroxyl group or is joined to X" below to form a carbon-carbon bond, or X and X' together form an oxo group or a dialkylaminoalkoxyimino group of the formula .dbd.N--O--(CH2)p--Am, in which p is 2 or 3 and Am is a dialkylamino group, it being possible for each alkyl to contain from 1 to 4 carbon atoms;

Y is a nitrogen atom or a group C(X"), in which X" is hydrogen or forms a carbon-carbon bond with X'; Q is hydrogen, a C1-C4 alkyl group or an aminoalkyl group of the formula --(CH2)q--Am', in which q is 2 or 3 and Am' is a piperidino, 4-benzylpiperidino or dialkylamino group, it being possible for each alkyl to contain from 1 to 4 carbon atoms;

R is hydrogen, a methyl group or a group (CH2)n--L, in which n is an integer from 2 to 6 and L is hydrogen or an amino group;

T is a group selected from W being an oxygen or sulfur atom; and Z is either hydrogen, or M or OM when T is the group --C(.dbd.O)--, or M when T is the group --C(.dbd.W)--NH--, M being hydrogen; a linear or branched C1-C6 alkyl; a phenylalkyl in which the alkyl group contains from 1 to 3 carbon atoms and which is unsubstituted or mono- or poly-substituted on the aromatic ring by a halogen, a hydroxyl, an alkoxy having 1 to 4 carbon atoms or an alkyl having 1 to 4 carbon atoms; a pyridylalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a naphthylalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a pyridylthioalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a styryl; a 1-methylimidazol-2-yl-thioalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a 1-oxophenyl-3-

indan-2-yl; or an unsubstituted or mono- or poly-substituted aromatic or heteroaromatic group; or to one of their salts with mineral or organic acids.

The salts of the compounds of formula (I) according to the present invention include those with mineral or organic acids which permit a suitable separation or crystallization of the compounds of formula (I), such as picric acid, oxalic acid or an optically active acid, for example a mandelic or camphosulfonic acid, as well as those which form pharmaceutically acceptable salts such as the hydrochloride, hydrobromide, sulfate, hydrogensulfate, dihydrogenphosphate, methanesulfonate, methylsulfate, maleate, fumarate, naphthalene-2-sulfonate, glycolate, gluconate, citrate and isethionate.

In particular, in formula (I), Z is a mono-, di- or tri-cyclic aromatic or heteroaromatic group which can carry one or more substituents and in which a carbon atom of the aromatic carbocycle or of the aromatic heterocycle is directly bonded to the group T.

More particularly, the radical Z can be a phenyl group which can be unsubstituted or may contain one or more substituents.

When Z is a phenyl group, this can preferably be mono- or di-substituted, especially in the 2,4-positions, but also for example in the 2,3-, 4,5-, 3,4- or 3,5-positions; it can also be trisubstituted, especially in the 2,4,6-positions, but also for example in the 2,3,4-, 2,3,5-, 2,4,5- or 3,4,5-positions, tetrasubstituted, for example in the 2,3,4,5-positions, or pentasubstituted. The substituents of the phenyl group can be: F; Cl; Br; I; CN; OH; NH₂; NH-CO-NH₂; NO₂; CONH₂; CF₃; C₁-C₁₀ alkyl, preferably C₁-C₄ alkyl, methyl or ethyl being preferred, as well as, for example, n-propyl, isopropyl, n-butyl, isobutyl, sec-butyl, tert-butyl, pentyl or n-pentyl, hexyl or n-hexyl, heptyl or n-heptyl, octyl or n-octyl, nonyl or n-nonyl or decyl or n-decyl; alkenyl containing 2 to 10 carbon atoms, preferably 2-4 carbon atoms, for example vinyl, allyl, prop-1-enyl, isopropenyl, butenyl or but-1-en-1-, -2-, -3- or -4-yl, but-2-en-1-yl, but-2-en-2-yl, pentenyl, hexenyl or decenyl; alkynyl containing 2 to 10 carbon atoms, preferably 2-4 carbon atoms, for example ethynyl, prop-1-yn-1-yl, propargyl, butynyl or but-2-yn-1-yl, pentynyl or decynyl; cycloalkyl containing 3 to 8 carbon atoms, preferably 5 or 6 carbon atoms, cyclopentyl or cyclohexyl being preferred, as well as, for example, cyclopropyl, cyclobutyl, 1-, 2- or 3-methylcyclopentyl, 1-, 2-, 3- or 4-methylcyclohexyl, cycloheptyl or cyclooctyl; bicycloalkyl containing 4 to 11 carbon atoms, preferably 7 carbon atoms, exo- or endo-2-norbornyl being preferred, as well as, for example, 2-isobornyl or 5-camphyl; hydroxyalkyl containing 1 to 5 carbon atoms, preferably 1-2 carbon atoms, hydroxymethyl and 1- or 2-hydroxyethyl being preferred, as well as, for example, 1-hydroxyprop-1-yl, 2-hydroxyprop-1-yl, 3-hydroxyprop-1-yl, 1-hydroxyprop-2-yl, 1-hydroxybut-1-yl or 1-hydroxypent-1-yl; alkoxy containing 1 to 10 carbon atoms, preferably 1-4 carbon atoms, methoxy or ethoxy being preferred, as well as, for example, n-propoxy, isopropoxy, n-butoxy, isobutoxy, sec-butoxy, tert-butoxy, pentoxy, hexyloxy, heptyloxy, octyloxy, nonyloxy or decyloxy; alkoxyalkyl containing 2 to 10 carbon atoms, preferably from 2 to 6 carbon atoms, for example alkoxyethyl or alkoxyethyl, such as methoxymethyl or 1- or 2-methoxyethyl, 1- or 2-n-butoxyethyl or 1- or 2-n-octyloxyethyl; alkoxyalkoxyalkyl containing up to 10 carbon atoms, preferably from 4 to 7 carbon atoms, for example alkoxyalkoxymethyl such as 2-methoxyethoxymethyl, 2-ethoxyethoxymethyl or 2-isopropoxyethoxymethyl, or alkoxyalkoxyethyl such as 2-(2-methoxyethoxy)ethyl or 2-(2-ethoxyethoxy)ethyl; alkoxyalkoxy containing from 2 to 10 carbon atoms, preferably from 3 to 6 carbon atoms, for example 2-methoxyethoxy, 2-ethoxyethoxy or 2-n-butoxyethoxy; alkenyloxy containing 2 to 10 carbon atoms, preferably 2 to 4 carbon atoms, allyloxy being preferred, as well as, for example, vinyloxy, propenyloxy, isopropenyloxy, butenyloxy such as but-1-en-1-, -2-, -3- or -4-yloxy, but-2-en-1-yloxy or but-2-en-2-yloxy, pentenyloxy, hexenyloxy or decenyloxy; alkenyloxyalkyl having up to 10 carbon atoms, preferably 3-6 carbon atoms, for example allyloxymethyl; alkynyloxy containing from 2 to 10 carbon atoms, preferably 2 to 4 carbon atoms, propargyloxy being preferred, as well as, for example, ethynyloxy, prop-1-yn-1-yloxy, butynyloxy or but-2-yn-1-yloxy, pentynyloxy or decynyloxy; alkynyloxyalkyl containing from 3 to 10 carbon atoms, preferably 3 to 6 carbon atoms, for example ethynyloxymethyl, propargyloxymethyl or 2-(but-2-yn-1-yloxy)ethyl; cycloalkoxy containing 3 to 8 carbon atoms, preferably 5 or 6 carbon atoms, cyclopentoxy or cyclohexyloxy being preferred, as well as, for example, cyclopropoxy, cyclobutoxy, 1-, 2- or 3-methylcyclopentoxy, 1-, 2-, 3- or 4-methylcyclohexyloxy, cycloheptyloxy or cyclooctyloxy; alkylthio containing from 1 to 10 carbon atoms, preferably 1 to 4 carbon atoms, methylthio or ethylthio being preferred, as well as, for example, n-propylthio, isopropylthio, n-butylthio, isobutylthio, sec-butylthio, tert-butylthio, pentylthio, hexylthio, octylthio, nonylthio or decylthio; alkylthioalkyl containing from 2 to 10 carbon atoms, preferably 2 to 6 carbon atoms, for example methylthiomethyl, 2-methylthioethyl or 2-n-butylthioethyl; acylamino, namely alkanoylamino containing from 1 to 7 carbon atoms, preferably 1 to 4 carbon atoms, formylamino and acetylamino being preferred, as well as

propionylamino, butyrylamino, isobutyrylamino, valerylamino, caproylamino or heptanoylamino, or aroylamino or benzoylamino; acylaminoalkyl, preferably alkanoylaminoalkyl containing from 2 to 8 carbon atoms, preferably 3 to 6 carbon atoms, such as formylaminoethyl, acetylaminooethyl, propionylaminoethyl, n-butyrylaminoethyl, formylaminopropyl, acetylaminopropyl, propionylaminopropyl, formylaminobutyl or acetylaminobutyl, as well as propionylaminobutyl or butyrylaminobutyl; acyloxy containing from 1 to 6 carbon atoms, preferably 2 to 4 carbon atoms, acetoxy, propionyloxy or butyryloxy being preferred, as well as, for example, formyloxy, valeroxy or caproxy; alkoxy carbonyl containing from 2 to 5 carbon atoms, preferably 2 or 3 carbon atoms, methoxycarbonyl and ethoxycarbonyl being preferred, as well as, for example, n-propoxycarbonyl, isopropoxycarbonyl, n-butoxycarbonyl, isobutoxycarbonyl, sec-butoxycarbonyl or tert-butoxycarbonyl; cycloalkoxycarbonyl containing from 4 to 8 carbon atoms, preferably 6 or 7 carbon atoms, cyclopropoxycarbonyl, cyclobutoxycarbonyl or cycloheptyloxycarbonyl; alkyl-aminocarbonylamino containing from 2 to 4 carbon atoms, such as methylaminocarbonylamino, ethylaminocarbonylamino or propylaminocarbonylamino; dialkylaminocarbonylamino containing from 3 to 7 carbon atoms, preferably 3 to 5 carbon atoms, dimethylaminocarbonylamino being preferred, as well as di-n-propylaminocarbonylamino or diisopropylaminocarbonylamino; pyrrolidin-1-ylcarbonylamino; piperidin-1-ylcarbonylamino; cycloalkylaminocarbonylamino containing from 4 to 8 carbon atoms, preferably 6 or 7 carbon atoms, cyclopentylaminocarbonylamino and cyclohexylaminocarbonylamino being preferred, as well as cyclopropylaminocarbonylamino, cyclobutylaminocarbonylamino or cycloheptylaminocarbonylamino; alkylaminocarbonylaminoalkyl containing from 3 to 9 carbon atoms, preferably 4 to 7 carbon atoms, methylaminocarbonylaminoethyl, ethylaminocarbonylaminoethyl, ethylaminocarbonylaminopropyl and ethylaminocarbonylaminobutyl being preferred, as well as, for example, methylaminocarbonylaminomethyl, n-propylaminocarbonylaminobutyl and n-butylaminocarbonylaminobutyl; dialkylaminocarbonylaminomethyl, diethylaminocarbonylaminomethyl, diethylaminocarbonylaminobutyl; pyrrolidin-1-ylcarbonylaminoethyl; cycloalkylaminocarbonylaminomethyl containing from 5 to 12 carbon atoms, preferably 8 to 11 carbon atoms, cyclopentylaminocarbonylaminoethyl, cyclopentylaminocarbonylaminobutyl, cyclohexylaminocarbonylaminoethyl, cyclohexylaminocarbonylaminopropyl and cyclohexylaminocarbonylaminobutyl being preferred, as well as, for example, cyclopropylaminocarbonylaminomethyl or cycloheptylaminocarbonylaminoethyl; alkoxy carbonylaminomethyl containing from 3 to 12 carbon atoms, preferably 4 to 9 carbon atoms, methoxycarbonylaminoethyl, ethoxycarbonylaminoethyl, n-propoxycarbonylaminoethyl, isopropoxycarbonylaminoethyl, n-butoxycarbonylaminoethyl, isobutoxycarbonylaminoethyl, sec-butoxycarbonylaminoethyl, tert-butoxycarbonylaminoethyl, ethoxycarbonylaminopropyl, n-butoxycarbonylaminopropyl, ethoxycarbonylaminobutyl and n-butoxycarbonylaminobutyl being preferred, as well as, for example, n-propoxycarbonylaminopropyl, n-propoxycarbonylaminobutyl or isopropoxycarbonylaminobutyl; cycloalkoxycarbonylaminomethyl containing from 5 to 12 carbon atoms, preferably 8 to 11 carbon atoms, cyclopropoxycarbonylaminomethyl, cyclopropoxycarbonylaminopropyl, cyclopropoxycarbonylaminobutyl, cyclohexyloxycarbonylaminoethyl, cyclohexyloxycarbonylaminopropyl and cyclohexyloxycarbonylaminobutyl being preferred, as well as, for example, cyclopropoxycarbonylaminomethyl or cycloheptyloxycarbonylaminoethyl; carbamoylalkyl containing from 2 to 5 carbon atoms, preferably 2 carbon atoms, carbamoylmethyl being preferred, as well as carbamoylethyl, carbamoylpropyl or carbamoylbutyl; alkylaminocarbonylalkyl containing from 3 to 9 carbon atoms, preferably 3 to 6 carbon atoms, methylaminocarbonylethyl, ethylaminocarbonylmethyl, n-propylaminocarbonylmethyl, isopropylaminocarbonylmethyl, n-butylaminocarbonylmethyl, isobutylaminocarbonylmethyl, sec-butylaminocarbonylmethyl and tert-butylaminocarbonylmethyl being preferred, as well as, for example, ethylaminocarbonylethyl, ethylaminocarbonylpropyl, ethylaminocarbonylbutyl, n-propylaminocarbonylbutyl or n-butylaminocarbonylbutyl; dialkylaminocarbonylalkyl containing from 4 to 11 carbon atoms, preferably 4 to 8 carbon atoms, dimethylaminocarbonylmethyl, diethylaminocarbonylmethyl, di-n-propylaminocarbonylmethyl, as well as, for example, diethylaminocarbonylethyl, diethylaminocarbonylpropyl, diethylaminocarbonylbutyl; pyrrolidin-1-ylcarbonylmethyl; piperidin-1-ylcarbonylmethyl; piperidin-1-yl carbonylethyl; cycloalkylaminocarbonylalkyl containing from 5 to 12 carbon atoms, preferably 7 or 8 carbon atoms, cyclopentylaminocarbonylmethyl and cyclohexylaminocarbonylmethyl being preferred, as well as, for example, cyclopropylaminocarbonylmethyl, cyclobutylaminocarbonylmethyl, cycloheptylaminocarbonylmethyl, cyclohexylaminocarbonylethyl, cyclohexylaminocarbonylpropyl or cyclohexylaminocarbonylbutyl; alkylaminocarbonylalkoxy containing from 3 to 10 carbon atoms, preferably 3 to 5 carbon atoms, methylaminocarbonylmethoxy being preferred, as well as, for example, methylaminocarbonylethoxy or methylaminocarbonylpropoxy; dialkylaminocarbonylalkoxy containing from 4 to 10 carbon atoms,

preferably 4 to 7 carbon atoms, such as dimethylaminocarbonylmethoxy, diethylaminocarbonylethoxy or piperidin-1-ylcarbonylmethoxy; and cycloalkylaminocarbonylalkoxy containing from 5 to 11 carbon atoms, preferably 7 or 8 carbon atoms, such as cyclopentylaminocarbonylmethoxy or cyclohexylaminocarbonylmethoxy.

The group Z may advantageously be a phenyl group; a benzyl group; a benzoyl group; or a phenylthioalkyl group in which the alkyl is C1 -C3.

The phenyl group Z is preferably mono- or di-substituted by a halogen, the 2,4-dichlorophenyl group being particularly preferred.

The radical Z can also be a bicyclic aromatic group such as naphth-1- or -2-yl or inden-1-, -2-, -3-, -4-, -5-, -6- or -7-yl, in which one or more bonds can be hydrogenated, it being possible for said groups to be unsubstituted or to contain one or more substituents such as: a halogen, and more particularly a fluorine atom, and alkyl, phenyl, cyano, hydroxyalkyl, hydroxyl, oxo, alkylcarbonylamino, alkoxy carbonyl and thioalkyl groups, in which the alkyls are C1 -C4.

The radical Z can also be a pyridyl, thiadiazolyl, indolyl, indazolyl, imidazolyl, benzimidazolyl, quinolyl, benzotriazolyl, benzofuranyl, benzothienyl, benzothiazolyl, benzisothiazolyl, isoquinolyl, benzoxazolyl, benzisoxazolyl, benzoxazinyl, benzodioxinyl, isoxazolyl, benzopyranyl, thiazolyl, thienyl, furyl, pyranyl, chromenyl, isobenzofuranyl, pyrrolyl, pyrazolyl, pyrazinyl, pyrimidinyl, pyridazinyl, indolizinyl, phthalazinyl, quinazolinyl, acridinyl, isothiazolyl, isochromanyl or chromanyl group, in which one or more double bonds can be hydrogenated, it being possible for said groups to be unsubstituted or to contain one or more substituents such as: alkyl, phenyl, cyano, hydroxyalkyl, hydroxyl, alkylcarbonylamino, alkoxy carbonyl and thioalkyl groups, in which the alkyls are C1 -C4.

According to another of its features, the present invention relates to a method of preparing variously substituted aromatic amino compounds of formula (I) and their salts, which comprises

a) treating a free amine of the formula in which m, Ar' and Q are as defined above; R DEG is hydrogen, a methyl group or a group (CH₂)_n --L DEG, in which n is as defined above and L DEG is hydrogen or an amino group protected by an N-protecting group; and E is a hydroxyl group, an O-protected group such as tetrahydropyran-2-yloxy, or a group in which Ar, X and Y are as defined above and X DEG is the group X' as defined above, in which the hydroxyl group is protected by an O-protecting group, either with a functional derivative of an acid of the formula

HO--CO--Z (III)

in which Z is as defined above, when it is intended to prepare a compound of formula (I) in which T is --CO--, or with an iso(thio)cyanate of the formula

W.dbd.C.dbd.N--Z (III')

in which W and Z are as defined above, when it is intended to prepare a compound of formula (I) in which T is --C(W)--NH--, in order to form the compound of the formula

b) then, when E is tetrahydropyran-2-yloxy, eliminating the tetrahydropyranyl group by acid hydrolysis, this hydrolysis being alternatively carried out in step a), on the starting amine of formula (II),

c) treating the resulting N-substituted alkanolamine of the formula with methanesulfonyl chloride,

d) reacting the resulting mesylate of the formula with a secondary amine of the formula in which Ar, Y, X and X' are as defined above, and

e) eliminating any O-protecting and N-protecting groups present and, if appropriate, converting the resulting product into one of its salts.

The functional derivative of the acid (III) used is the acid itself, suitably activated for example by cyclohexylcarbodiimide or by benzotriazolyl-N-oxytrisdimethylaminophosphonium hexafluorophosphate (BOP), or one of the functional derivatives which react with amines, for example an anhydride, a mixed anhydride, the chloride or an activated ester. When Z is a group OM, the acid in question is carbonic acid and the functional derivative used is the monochloride, namely a chloroformate Cl--CO--OM.

Any N-protecting groups present in the group R DEG of the compound of formula (II) are the conventional N-protecting groups well known to those skilled in the art, and preferably those which can be eliminated by acid hydrolysis, such as the trityl and methoxytrityl groups.

Any O-protecting groups present in the group X DEG are also the conventional O-protecting groups well known to those skilled in the art, and preferably those which can be eliminated by mild acid hydrolysis, such as the tetrahydropyran-2-yl, t-butyldimethylsilyl and methoxymethyl groups.

When the starting material used is a compound of formula (II) in which E is a group the method of the present invention can be represented and illustrated in detail by Scheme 1 below:

In formula (IIIa) above, the acid chloride is considered to be a reactive functional derivative of the acid (III). The acid chloride is used when it is desired to prepare a compound (I') in which Z is OM. The reaction with the acid chloride is performed in an inert solvent such as methylene chloride or benzene, in the presence of a base such as, for example, triethylamine, at room temperature.

In the particular case where Z=OM, the reaction of the compound (II') with the chloroformate of the formula is performed by the usual methods.

When Z is other than OM, it is possible to use another functional derivative or to start from the free acid (III), carrying out a coupling reaction of (II') with BOP (benzotriazolyl-N-oxytrisdimethylaminophosphonium hexafluorophosphate) and then adding the acid (III) in the presence of an organic base such as, for example, triethylamine, in a solvent such as methylene chloride or dimethylformamide, at room temperature, the compounds (I') obtained being isolated and purified by the usual methods such as, for example, chromatography or recrystallization.

It is also possible to react (II') with an iso(thio)cyanate W.dbd.C.dbd.N--Z (III') in an anhydrous inert solvent such as, for example, benzene, overnight at room temperature, and then to treat the reaction mixture by the usual methods to give the compounds (I').

When the starting material used is a compound of formula (II) in which E is a tetrahydropyranloxy group, the method of the present invention can be represented and illustrated by Scheme 2.

The reactions of the compound (II') with the reactants (IIIa) and (III') take place as described above for Scheme 1, it being possible for the acid chloride (IIIa) to be replaced with another functional derivative or with the free acid activated for example by BOP

The resulting intermediate (IV') is deprotected by acid hydrolysis to give the free hydroxylated compound (V). Deprotection by hydrolysis of the tetrahydropyranloxy group can be carried out direct on the compound (II'). This gives the hydroxylated compound (II''), which is reacted direct with the reactant (IIIa) or (III'), as described in Scheme 2 below, to give the compound (V). This is followed by preparation of the mesylate (VI) and then substitution with a secondary amine of formula (VII), which finally gives the compounds (I) according to the invention after deprotection of the amine L DEG if appropriate.

When the product obtained at the end of the reaction of the compound of formula (II) with the compound (III) (as a functional derivative) or (III') has formula (IV) in which E is a group in which Ar, X, X DEG and Y are as defined above, the product can either be the final product or have an O-protected hydroxyl group (in X DEG) or a protected amino group (L DEG) or both. In this last case, it is desirable to use the O-protecting and N-protecting groups in the starting material (II) so as to be able to hydrolyze them at the same time.

Deprotection is carried out by the known methods; in particular, if a tetrahydropyranyl group is used as the O-protecting group, hydrolysis can be carried out under mild conditions with dilute p-toluenesulfonic acid. If the molecule of the product (IV) contains both a tetrahydropyranloxy group and a tritylamino group, hydrolysis of the former can thus be carried out without affecting the N-protecting group, whereas formic acid removes both protecting groups at the same time.

The resulting products of formula (I) are isolated, in the form of the free base or a salt, by the conventional techniques.

When the compound of formula (I) is obtained in the form of the free base, salt formation is effected by

treatment with the chosen acid in an organic solvent. Treatment of the free base, for example dissolved in an alcohol such as isopropanol, with a solution of the chosen acid in the same solvent gives the corresponding salt, which is isolated by the conventional techniques. The hydrochloride, hydrobromide, sulfate, hydrogensulfate, dihydrogenphosphate, methanesulfonate, methylsulfate, oxalate, maleate, fumarate and naphthalene-2-sulfonate, for example, are prepared in this way.

When the reaction is complete, the compounds of formula (I) can be isolated in the form of one of their salts, for example the hydrochloride or the oxalate; in this case, where necessary, the free base can be prepared by neutralization of said salt with a mineral or organic base such as sodium hydroxide or triethylamine, or with an alkali metal carbonate or bicarbonate such as sodium or potassium carbonate or bicarbonate.

The enantiomers, which form part of the invention, can be isolated by resolution of the racemic mixtures (I).

It is also possible to resolve racemic mixtures of the products of formula (II), especially the products of formulae (II') and (II'') or precursors thereof, in order to prepare the enantiomers of the products of formula (I).

The starting compounds of formula (II) are prepared from nitriles of the formula in which m, E, Q and Ar' are as defined above, by reduction and, if appropriate, alkylation of the amine obtained.

To prepare the compounds of formula (II) in which R DEG is hydrogen, the starting nitriles of formula (VIII) are hydrogenated in an alkanol such as ethanol, in the presence of a catalyst such as, for example, Raney nickel, and the free primary amine can be isolated by the conventional methods.

When it is desired to prepare the compounds of formula (II) in which R DEG is methyl, the free amine, obtained by hydrogenation of the nitrile (VIII) as described above, is treated with a chloroformate, for example with the chloroformate of the formula Cl--CO--OAlk, in which Alk is a C1 -C4 alkyl, preferably ethyl, to give the carbamates of the formula which are then reduced by known means such as reaction with a reducing agent like, for example, a metal hydride such as sodium aluminum hydride or lithium aluminum hydride, or a boron hydride such as borane dimethylsulfide. Reduction is carried out in a solvent such as ether or toluene, at a temperature between room temperature and 60 DEG C. The resulting methylamine of the formula is isolated by the usual methods.

To prepare the compounds of formula (II) in which R DEG is a group --(CH₂)_n--L DEG, in which n and L DEG are as defined above, the free amine, obtained by hydrogenation of the nitrile (VIII) as described above, is treated with a reactive functional derivative of the acid of the formula L DEG--(CH₂)_{n-1}--COOH (IX)

to give an amide of the formula in which m, n, E, Ar', Q and L DEG are as defined above.

On reduction under the same conditions as those described above for the nitrile (VIII), the amide (X) gives the desired compound of the formula

The nitriles of formula (VIII) are prepared from known nitriles (commercially available or prepared by known methods) of the formula which, on alkylation with a compound of the formula E--(CH₂)_m--J (XII)

in which m and E are as defined above and J is a halogen atom, for example a bromine atom, or a hydroxyl group, give the desired compounds (VIII).

The nitriles of formula (VIII) in which E is a tetrahydropyranloxy group are synthesized from a tetrahydropyranloxy derivative (THP--O--) obtained by reacting an alkanol of the formula Br--(CH₂)_m--OH, where

m is as defined above, with dihydropyran to give the compound which is then added, in the presence of an alkali metal hydride, to the acetonitrile derivative (XI) in order to prepare the intermediate corresponding to the compound of formula (VIII), which is an intermediate precursor of the compound (II') in Scheme 1 above in which Q is hydrogen, which can then be alkylated.

The nitriles of formula (VIII) in which E is a group in which Ar, X, X DEG and Y are as defined above, are

synthesized by known methods involving the addition of a nitrile derivative of the formula to chlorinated derivatives of the formula in the presence of sodium amide, in a solvent such as toluene, at temperatures of between 30 DEG and 80 DEG C.

The chlorinated derivative (XIII) is prepared by reacting a chlorinating reagent such as thionyl chloride, for example, with the hydroxylated derivative of the formula which is itself prepared from the amine of the formula by reaction with ethylene oxide if m=2 and a 3-halogenopropanol if m=3.

The amines (II) are novel products which form the key intermediates for the preparation of the compounds of formula (I) above. Moreover, it has been found, surprisingly, that like the compounds of formula (I), although to a lesser degree, the amines of formula (II') possess a good antagonistic activity towards neurokinin receptors. The activity of these compounds extends to the derivatives deprotected by the conventional methods referred to above (X DEG=X' and R DEG=R).

Thus, according to another of its features, the present invention relates to compounds of the formula in which: E DEG DEG is a tetrahydropyranoxy group, a hydroxyl group, or a group m is 2 or 3; Ar and Ar' independently are a thienyl group; a phenyl group which is unsubstituted or mono- or di-substituted by a halogen atom, preferably a chlorine or fluorine atom, by a C1 -C3 alkyl, by a trifluoromethyl, by an alkoxy in which the alkyl is C1 -C3, by a hydroxyl or by a methylenedioxy; or an imidazolyl group; it being possible for Ar' to be a benzothienyl group which is unsubstituted or substituted by a halogen, preferably by a chlorine or fluorine atom; a naphthyl group which is unsubstituted or substituted by a halogen, preferably by a fluorine atom; a biphenyl group; or an indolyl which is unsubstituted or substituted on the nitrogen by a benzyl group;

X is hydrogen;

X DEG DEG is hydrogen or a hydroxyl group which is free or protected by an O-protecting group, or is joined to

X" below to form a carbon-carbon bond,

or X and X DEG DEG together form an oxo group or a di-alkylaminoalkoxyimino group of the formula .dbd.N--O--(CH2)p --Am, in which p is 2 or 3 and Am is a dialkylamino group, it being possible for each alkyl to contain from 1 to 4 carbon atoms;

Y is a nitrogen atom or a group C(X"), in which X" is hydrogen or forms a carbon-carbon bond with X DEG DEG;

Q is hydrogen, a C1 -C4 alkyl group or an aminoalkyl group of the formula --(CH2)q --Am', in which q is 2 or 3 and Am' is a piperidino, 4-benzylpiperidino or di-alkylamino group, it being possible for each alkyl to contain from 1 to 4 carbon atoms; and

R DEG DEG is hydrogen, a methyl group or a group (CH2)n --L DEG DEG, in which n is a number from 2 to 6 and L DEG DEG is hydrogen or an amino group which is free or protected by an N-protecting group;

or to one of their salts.

The compounds of formula (XVI) include the compounds of formula (II) which are protected compounds, as well as the corresponding deprotected compounds.

The compounds of formula XVI, provided that

when m=2, E DEG DEG is a hydroxyl group, R DEG DEG is hydrogen and Ar' is an unsubstituted phenyl, then Q is different from H ethyl or propyl

when m=2, E DEG DEG is a hydroxyl group, R DEG DEG is hydrogen and Q is hydrogen, then Ar' is

different from a 3,4-dimethoxyphenyl group or a 2-thienyl group

m=3, E DEG DEG is a hydroxyl group, Ar' is an unsubstituted phenyl, Q is ethyl, then R DEG DEG is not hydrogen

are novel products.

They are obtained by the process described above for the obtention of compounds of formula (II), in which each step may be eventually followed by the elimination of N- and O-protecting groups. They may then be transformed into salts with optically active acids, which allows the preparation of optically pure compounds.

The compounds of formula (XVI) which are particularly preferred are those in which E DEG DEG is a hydroxyl group and R DEG DEG is hydrogen; these compounds and their enantiomers are the compounds of formula (II").

The intermediates of formula (IV) in which E is tetrahydropyranloxy and the intermediates of formula (V) and of formula (VI) are particularly advantageous novel products and represent a further feature of the present invention. These products, and the corresponding compounds from which the O- and N-protecting groups have been removed by conventional methods, can be jointly represented by formula (V') below: in which: m is 2 or 3;

G is hydrogen, a tetrahydropyanyl group or a methanesulfonyl group;

Ar' is a thiaryl group; a phenyl group which is unsubstituted or mono- or di-substituted by a halogen atom, preferably a chlorine or fluorine atom, by a trifluoromethyl group, by an alkoxy in which the alkyl is C1 -C3 or by a hydroxyl; a benzothienyl group which is unsubstituted or substituted by a halogen; a naphthyl group which is unsubstituted or substituted by a halogen, preferably a fluorine atom; a biphenyl group; or an indolyl group which is unsubstituted or substituted on the nitrogen by a benzyl;

Q is hydrogen or an aminoalkyl group of the formula -(CH₂)_q-Am', in which q is 2 or 3 and Am' is a piperidino, 4-benzylpiperidino or dialkylamino group, it being possible for each alkyl to contain from 1 to 4 carbon atoms;

R DEG DEG is hydrogen, a methyl group or a group (CH₂)_n-L DEG DEG, in which n is an integer from 2 to 6 and L DEG DEG is hydrogen or an amino group which is free or protected by an N-protecting group; T is a group selected from W being an oxygen or sulfur atom; and Z is either hydrogen, or M or OM when T is the group -C.(dbd.O)-, or M when T is the group -C.(dbd.W)-NH-, M being hydrogen; a linear or branched C1 -C6 alkyl; a phenylalkyl in which the alkyl group contains from 1 to 3 carbon atoms and which is unsubstituted or mono- or poly-substituted on the aromatic ring by a halogen, a hydroxyl, an alkoxy having 1 to 4 carbon atoms or an alkyl having 1 to 4 carbon atoms; a pyridylalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a naphthylalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a pyridylthioalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a styryl; a 1-methylimidazol-2-ylthioalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a 1-oxophenyl-3-indan-2-yl; or an unsubstituted or mono- or poly-substituted aromatic or heteroaromatic group;

and their salts with mineral or organic acids.

The compounds of formula (V') provided that when m=3, G is hydrogen, Ar' is an unsubstituted phenyl group, Q is an ethyl group, and Z is a methyl group, then R DEG DEG is different from hydrogen, are novel compounds. These compounds are prepared according to Steps a), b) and c) of the method described above for the preparation of the compounds of formula (I), which are eventually followed by the elimination of N-protecting groups after each step, except that a free amine of the formula in which m, G, Q, Ar' are as defined above and R DEG is hydrogen, a methyl group, a group (CH₂)_n-L DEG in which n is an integer from 2 to 6 and L DEG is hydrogen or an amino group protected by an N-protecting group is used as the starting material.

As indicated above, the intermediates which are capable of giving salts with optically active acids can be resolved so as to make it possible to prepare the enantiomers of the compounds of formula (I).

It is also possible to make provision for the stereospecific synthesis of intermediates which do not give a salt permitting separation.

A particularly suitable intermediate for such a stereospecific synthesis is the alcohol of formula (V) above.

Thus, according to another of its features, the present invention relates to the enantiomers and to a method of preparing the enantiomers of the compounds of formula (I) and their salts; said enantiomers have formula (I*) below: in which: Ar, Ar', Z, X, X', Y, Q, R, T and m are as defined above and "*" means that the carbon atom denoted by this symbol has a defined (+) or (-) absolute configuration.

This method comprises treating a compound of the formula in a solvent such as, for example, dioxane, in an acid medium, for example in the presence of hydrochloric acid, to give the amino acid of the formula which is esterified in an alkanol AlkOH, in which Alk is an alkyl having 1 to 4 carbon atoms, in an acid medium, and then treating the corresponding ester of the formula in which Alk, Q, Ar', R DEG and m are as defined above, either with a functional derivative of an acid of the formula HO-CO-Z (III)

or with an iso(thio)cyanate of the formula

W.dbd.C.dbd.N-Z (III')

Z and W being as defined above,

under operating conditions identical to those used for the preparation of the derivatives (IV) above, to give the ester of the formula which is then reduced to the corresponding alcohol of the formula

These alcohols (V*) correspond to the compounds of formula (V') above in which m, Q, T, Ar' and Z are as defined above, G is hydrogen and R DEG DEG is R DEG, the latter being as defined above, said compounds being in optically pure form. These compounds are novel and form part of the invention.

The alcohol (V*) is converted into the methane-sulfonate derivative of the formula under operating conditions identical to those used for the preparation of the derivatives (VI) above.

The derivatives (VI*) correspond to the compounds of formula (V') above in which m, Q, T, Ar' and Z are as defined above, G is methanesulfonyl and R DEG DEG is R DEG, the latter being as defined above, said compounds being in optically pure form. These compounds are novel and form part of the invention.

Substitution of the mesylate (VI*) with an amine of the formula under the conditions described for the preparation of (I) above makes it possible to prepare the derivatives (I*), after deprotection if appropriate, these derivatives being eventually transformed into one of their salts, using known methods.

The compounds of formula (XVII*) are known or can easily be prepared by the method described by G. HELMCHEN et al., Angew. Chem. Int. Ed. Engl., 1979, 1, 18, 65, according to the following scheme:

The resulting products of formula (I*) are isolated, in the form of the free base or a salt, by the conventional techniques.

When the compound of formula (I*) is obtained in the form of the free base, salt formation is effected by treatment with the chosen acid in an organic solvent. Treatment of the free base, for example, dissolved in an alcohol such as isopropanol, with a solution of the chosen acid in the same solvent gives the corresponding salt, which is isolated by the conventional techniques. The hydrochloride, hydrobromide, sulfate, hydrogensulfate, dihydrogenphosphate, methane-sulfonate, methylsulfate, oxalate, maleate, fumarate and naphthalene-2-sulfonate, for example, are prepared in this way.

When the reaction is complete, the compounds of formula (I*) can be isolated in the form of one of their salts, for example the hydrochloride or the oxalate; in this case, where necessary, the free base can be prepared by neutralization of said salt with a mineral or organic base.

The compounds according to the invention were subjected to biochemical and pharmacological tests.

The compounds (I) and (I*) and the compounds (XVI) in which and their salts showed antagonistic properties towards the binding of substance P in tests performed on rat cortical membranes and IM9 lymphoblast membranes, according to M. A. CASCIERI et al., J. Biol. Chem., 1983, 258, 5158-5164 and D. D. PAYA et al., J. Immunol., 1984, 133, 3260-3265.

The same compounds and their salts showed antagonistic properties towards the binding of NKA in tests performed on rat duodenal membranes, according to L. BERGSTROM et al., Mol. Pharmacol., 1987, 22, 764-771.

The same compounds and their salts showed antagonistic properties towards specific NK1, NK2 and NK3 receptor agonists in tests performed on different isolated organs, according to D. REGOLI et al., Trends Pharmacol. Sci., 1988, 9, 290-295.

The same compounds and their salts showed overall antagonistic properties towards NK1, NK2 and NK3 in tests performed on different isolated organs, according to D. REGOLI et al., Trends Pharmacol. Sci., 1988, 9, 290-295 and Pharmacology, 1989, 38, 1-15.

The same compounds and their salts showed antagonistic properties towards the hypermotility induced in rats by substance P in pharmacological tests performed according to Elliot et al., Brain Res., 1986, 381, 68-76.

The antagonistic properties towards the salivation induced in rats by substance P or a specific NK1 agonist ([Sar@9 Met(O2)@11]SP) were demonstrated by means of pharmacological tests performed according to TAKEDA Y. and KRAUSE J. E., Proc. Natl. Acad. Sci. USA, 1989, 86, 392-396.

The analgesic properties were demonstrated by means of pharmacological tests performed on arthritic rats according to V. KAYSER et al., Proceedings of the Vth World Congress on Pain, DUMMER R., GEBHART G. F. and BOND M. R. ed., Elsevier Biomedical Division, 1988, 72-79.

The compounds of the present invention have a low toxicity; in particular, their acute toxicity is compatible with their use as drugs. For such a use, an effective amount of a compound of formula (I), (I*) or (XVI) or of one of their pharmaceutically acceptable salts is administered to mammals.

The compounds of the present invention are generally administered in dosage units. Said dosage units are preferably formulated as pharmaceutical compositions in which the active principle is mixed with a pharmaceutical excipient.

Thus, according to another of its features, the present invention relates to pharmaceutical compositions containing, as the active principle, a compound of formula (I) or (I*) or of formula (XVI) or one of their pharmaceutically acceptable salts.

The compounds of formula (I), (I*) or (XVI) above and their pharmaceutically acceptable salts can be used at daily doses of 0.01 to 100 mg per kilo of body weight of the mammal to be treated, preferably at daily doses of 0.1 to 50 mg/kg. In humans, the dose can preferably vary from 0.5 to 4000 mg per day, more particularly from 2.5 to 1000 mg, depending on the age of the subject to be treated or the type of treatment: prophylactic or curative.

In the pharmaceutical compositions of the present invention for oral, sublingual, subcutaneous, intramuscular, intravenous, percutaneous, local or rectal administration, the active principles can be administered in unit forms of administration, mixed with conventional pharmaceutical carriers, to animals and to humans. The appropriate unit forms of administration include oral forms such as tablets, gelatin capsules, powders, granules and solutions or suspensions to be taken orally, sublingual and buccal forms of administration, subcutaneous, intramuscular, intravenous, intranasal or intraocular forms of administration and rectal forms of administration.

When a solid composition is prepared in the form of tablets, the main active principle is mixed with a pharmaceutical vehicle such as gelatin, starch, lactose, magnesium stearate, talc, gum arabic or the like. The tablets can be coated with sucrose or other appropriate substances or they can be treated so as to have a prolonged or delayed activity and so as to release a predetermined amount of active principle continuously.

A preparation in the form of gelatin capsules is obtained by mixing the active principle with a diluent and pouring the mixture obtained into soft or hard gelatin capsules.

A preparation in the form of a syrup or elixir can contain the active principle together with a sweetener, which is preferably calorie-free, methylparaben and propylparaben as antiseptics, a taste corrector and an appropriate colorant.

The water-dispersible granules or powders can contain the active principle mixed with dispersants or wetting agents, or suspending agents such as polyvinylpyrrolidone, as well as with sweeteners or taste correctors.

For rectal administration, suppositories are used which are prepared with binders melting at the rectal temperature, for example cacao butter or polyethylene glycols.

For parenteral, intranasal or intraocular administration, aqueous solutions, isotonic saline solutions or sterile injectable solutions are used which contain pharmacologically compatible dispersants and/or wetting agents, for example propylene glycol or butylene glycol.

The active principle can also be formulated as microcapsules, with one or more carriers or additives if appropriate.

The following Examples illustrate the invention without however implying a limitation.

EXAMPLE 1

N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichlorobenz amide hydrochloride
SR 45672 A A) 1-Amino-4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butane dihydrochloride

14.5 g of 4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyronitrile hydrochloride are dissolved in 400 ml of 95 DEG ethanol. A solution of 20 ml of concentrated ammonia in 40 ml of water and Raney nickel (10% by weight of the amount of amine) are added to the mixture, which is then placed under a hydrogen atmosphere, with vigorous stirring, for 4 hours, after which 1.67 l of hydrogen have been consumed. After filtration of the catalyst, the filtrate is concentrated under vacuum and the residue is taken up in ethyl acetate, washed with water, dried and concentrated under vacuum. The residue is taken up in a solution of hydrogen chloride in methanol, filtered off and recrystallized from a 3/7 acetone/ether mixture.

m=10.2 g

M.p. 210 DEG C.

B) SR 45672 A

2.3 g of the product obtained above and 1 g of 2,4-dichlorobenzoyl chloride are dissolved in 100 ml of methylene chloride in the presence of 0.03 g of triethylamine. The reaction mixture is stirred for 4 hours at room temperature and then concentrated under vacuum and the residue is taken up in water, extracted with ether, dried over MgSO₄ and concentrated under vacuum. The residue is chromatographed on silica gel using a 97/3 methylene chloride/methanol mixture as the eluent. Concentration of the pure fractions gives a residue, which is taken up in a solution of hydrogen chloride in ether.

m=1 g

M.p.=86 DEG-87 DEG C.

EXAMPLE 2

N-[5-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)pentyl]-2,4-dichlorobenz amide hydrochloride
SR 45083 A

If the procedure of Example 1 is followed, except that 5-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)pentynitrile is used as the starting material, SR 45083 A is obtained, which is recrystallized from a methylene chloride/pentane mixture.

M.p.=98 DEG-100 DEG C.

EXAMPLE 3

N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-difluorophenyl)butyl]-2,4-dimethylbenz amide hydrochloride hemihydrate
SR 46316 A

1.2 g of BOP are added to a solution of 1 g of 1-amino-3-(4-benzylpiperidin-1-yl)-2-(3,4-difluorophenyl)butane, 0.34 g of 2,4-dimethylbenzoic acid and 1 g of triethylamine in 50 ml of methylene chloride. The reaction mixture is stirred for one hour at room temperature and concentrated under vacuum. The residue is taken up in water, extracted with ether, washed with water and then with a solution of sodium bicarbonate, dried over MgSO₄ and then concentrated under vacuum. The residue is taken up in methylene chloride for preparation of the hydrochloride, which is filtered off and washed with ether.

m=0.4 g

M.p.=99 DEG-103 DEG C.

The compounds described in Tables 1 and 2 were prepared according to Example 1, 2 or 3.

In the formula below, the group Z indicated in formula I is a phenyl group which is unsubstituted or mono-, di- or tri-substituted by A, A' and A".

TABLE 1

Product SR M.p., DEGC. Recryst.
(Example n DEG)
Ar' A A' A" solvent. Salt

47807 A (4)
H H H 116 isopropyl ether HCl
46679 A (5)
2-F H H 100-102 pentane/ether HCl.0.5
H2 O
46101 A (6)
2-F 4-F H 81-84 CH2 Cl2 /ether
HCl.0.5 H2 O
46099 A (7)
2-F 4-F H 78-80 CH2 Cl2 /ether
HCl.0.5 H2 O
45966 A (8)
2-F 4-F H 83-86 isopropyl ether HCl.0.5
H2 O
46032 A (9)
2-Cl H H 186 ether HCl
47704 A (10)
3-Cl H H 158-160 AcOEt HCl
46454 A (11)
4-Cl H H 112-114 CH2 Cl2 /ether
HCl.0.5 H2 O
47462 A (12)
2-Cl 4-Cl H 95 ether HCl.0.5 H2 O
47801 A (13)
2-Cl 4-Cl H 108 ether HCl.0.5 H2 O
46100 A (14)
2-Cl 4-Cl H 95-97 CH2 Cl2 /ether
HCl.0.5 H2 O
46238 A (15)
2-Cl 4-Cl H 96-101 isopropyl ether HCl.0.5
H2 O
45910 A (16)
2-Cl 4-Cl H 83-85 CH2 Cl2 /ether
HCl
46152 A (17)
2-Cl 4-Cl H 94 pentane/ether HCl.0.5 H2
O
46011 A (18)
2-Cl 4-Cl H 107-110 ether HCl
45672 B (19a)
2-Cl 4-Cl H 88-90 pentane methanesulfonate
hydrate
45672 C (19b)
2-Cl 4-Cl H 70-72 pentane glycolate
45672 D (19c)
2-Cl 4-Cl H 144-146 pentane gluconate
45672 E (19d)
2-Cl 4-Cl H 103-105 pentane citrate hemihydrat
e
45672 F (19e)
2-Cl 4-Cl H 86-90 pentane isethionate
hemihydrate
45672 H (19f)
2-Cl 4-Cl H 136-138 methanol free base
46153 A (20)
2-Cl 4-Cl H 104-106 pentane/ether HCl
46183 A (21)
2-Cl 4-Cl H 117- 121 ether HCl
46364 A (22)
2-Cl 4-Cl H 92 CH2 Cl2 /ether
HCl.0.5 H2 O

47158 A (23)
2-Cl 4-Cl H 96-98 pentane/ether HCl
47225 A (24)
2-Cl 4-Cl H 92 pentane/ether HCl
46498 A (25)
2-Cl 4-Cl H 112-114 CH₂ Cl₂ /ether
HCl.0.5 H₂ O
45261 A (26)
2-Cl 4-Cl H 90-94 isopropanol methanesulfonate
4
45870 A (27)
2-Cl 4-Cl H 112-114 pentane HCl.0.5 H₂
O
46362 A (28)
2-Cl 4-Cl H 102 pentane HCl
47743 A (29)
2-Cl 4-Cl H 115-118 AcOEt HCl
46844 A (30)
2-Cl 4-Cl H 126-128 ether HCl.0.5 H₂ O
46360 A (31)
2-Cl 4-Cl H 138-144 CH₂ Cl₂ /ether
HCl
46206 A (32)
3-Cl 5-Cl H 108 CH₂ Cl₂ /ether 108
46236 A (33)
3-Cl 5-Cl H 90 CH₂ Cl₂ /ether HCl
46501 A (34)
2-Cl 6-Cl H 128-130 CH₂ Cl₂ /ether
HCl.0.5 H₂ O
46499 A (35)
2-Cl 4-I H 112-114 CH₂ Cl₂ /ether
HCl.0.5H₂ O
45871 A (36)
2-Cl 4-OH H 142-144 CH₂ Cl₂ /ether
HCl.0.5 H₂ O
46815 A (37)
2-Cl 4-CH₃
H 92 hexane HCl
47146 A (38)
2-Cl 4-NO₂
H 160-164 AcOEt HCl
46221 A (39)
4-OH H H 134 ether HCl
46315 A (40)
2-OH 4-OH H 136-141 CH₂ Cl₂ /ether
HCl.0.5 H₂ O
45911 A (41)
3-CF₃
H H 86-89 ether HCl.0.5 H₂ O
46561 A (42)
2-OCH₃
4-OCH₃
H 104 CH₂ Cl₂ /ether HCl
45912 A (43)
3-OCH₃
4-OCH₃
86-89 ether HCl.0.5 H₂ O
47800 A (44)
3-NO₂
4-F H 119 AcOEt HCl
46828 A (45)

2-NO₂
4-NO₂
H 112-120 isopropyl ether HCl
46758 A (46)

3-NO₂
5-NO₂
H 194-198 ether HCl
46184 A (47)
3-NO₂
5-NO₂
H 115-120 ether HCl
46526 A (48)

2-CH₃
4-CH₃
6-CH₃
128-130 CH₂ Cl₂ /ether
HCl
46888 A (49)

H H 175 ether HCl
46209 A (50)

H H 195 ether HCl
46560 A (51)

H H 132 CH₂ Cl₂ /ether HCl
46317 A (52)

H H 95-100 CH₂ Cl₂ /ether
HCl.0.5 H₂O
46672 A (53)

H H 134 ether HCl
46391 A (54)

H H 207 ethyl acetate 2HCl
46390 A (55)

H H 158 ethyl acetate 2HCl

TABLE 2

Product
SR M.p., DEGC.
(Exam- Recryst.
ple n DEG)
m Z solvent. Salt

45303 A
2 H --
(56) ether
HCl
47122 A

2 CH3 77
(57) ether
HCl
45599 A
2 CH2 CH3 170
(58) ether
HCl
47315 A
2 CH(CH3)2 170
(59) ether
HCl
47581 A
3 CH(CH3)2 150
(60) isopropyl
ether
HCl
47314 A
2 C(CH3)3 160
(61) ether
HCl
45946 A
2 CH2(CH2)2CH2 CH3
188
(62) ether
HCl
47144 A (63)
1
82-84 ether HCl
45305 A (64)
2
160 ether HCl.0.5 H2 O
47242 A (65)
3
122 ether HCl
47989 A (66)
3
104 isopropyl ether HCl
45947 A (67)
2
166 ether 2HCl
47721 A (68)
3
170 AcOEt HCl
47720 A (69)
3
185 AcOEt HCl
47909 A (70)
2
104 ether HCl
48043 A (71)
3
92 isopropyl ether HCl
46695 A (72)
2
100 (de- composition) ether HCl
46212 A (73)
2
218 ether HCl
46341 A (74)
2
224 acetone HCl

46669 A (75)
2
210 acetone HCl
46673 A (76)
2
158 ethyl acetate 2HCl
45880 A (77)
2
114-116 ether HCl
45841 A (78)
2
146 ether HCl
45792 A (79)
2
110 ether HCl
45869 A (80)
2
90-92 CH₂ Cl₂ /ether HCl
46215 A (81)
2
145 ether HCl
46213 A (82)
2
125 ether HCl
46028 A (83)
2
174 ether 2HCl
46389 A (84)
2
128 ethyl acetate 2HCl
46294 A (85)
2
168 ether 2HCl
45793 A
3 H 130
(86) ether
HCl

EXAMPLE 87

N'-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-N-naphth-1-ylur ea hydrochloride
SR 45924 A

2.52 g of 1-amino-4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butane are dissolved in 30 ml of anhydrous benzene, 1.09 g of naphth-1-yl isocyanate are then added and the reaction mixture is stirred overnight at room temperature. The excess isocyanate is decomposed by adding 10 ml of methanol and heating the mixture at the boil for 30 minutes.

The mixture is concentrated under vacuum and the residue is taken up in an ethyl acetate/water mixture, washed with a 10% solution of sodium hydroxide and then water, decanted, dried over MgSO₄ and concentrated under vacuum. The residue is taken up in acetone, a solution of hydrogen chloride in ether is then added and the hydrochloride is filtered off and solidified in ether.

m=3.3 g
M.p.=174 DEG C.

The compounds described in Table 3 were prepared according to Example 87.
TABLE 3

Product SR n DEG M.p., DEGC. Recryst.

(Example n DEG)
m Ar' Z W solvent. Salt

45924 B (87b)
2

0 158 ether methanesulfonate hemihydrate
45924 C (87c)
2

0 138 ether glycolate
45924 D (87d)
2

0 124 ethyl acetate gluconate
45924 E (87e)
2

0 148 hexane trifluoroacetate
45924 F (87f)
2

0 138 ether isethionate
45923 A (88)
2

0 182 ether HCl
45308 A (89)
2

0 120 ether HCl.0.5.H₂O
45673 A (90)
2

0 105-107 ether/isopropanol HCl.H₂O
45671 A (91)
2

S 96-98 hexane methanesulfonate
46670 A (92)
2

S 178 ether HCl
45903 A (93)
3

0 135 ether HCl
46987 A (94)
2

0 225 ether hydrochloride
46986 A (95)
2

0 215 ether hydrochloride

EXAMPLE 96

Benzyl N-[4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]carbamate hydrochloride
SR 46940 A

2.26 g of 1-amino-4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butane hydrochloride and 0.89 g of benzyl chloroformate are dissolved in 30 ml of methylene chloride. The mixture is cooled to 0 DEG C. and a solution of 1.52 g of triethylamine in 10 ml of methylene chloride is then added. The reaction mixture is left for 1 hour at room temperature and then concentrated under vacuum. The residue is taken up in water, extracted with ethyl acetate, washed with a 10% solution of sodium hydroxide and then a saturated solution of sodium chloride, dried over MgSO₄ and concentrated under vacuum. The residue is chromatographed on silica gel using a 96/4 methylene chloride/methanol mixture as the eluent. After concentration of the pure fractions under vacuum, the residue is taken up in ether, a solution of hydrogen chloride in ether is added and the hydrochloride is filtered off.

m=1.7 g
M.p.=130 DEG C.

EXAMPLE 97

Ethyl N-[4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]carbamate hydrochloride

9.8 g of 1-amino-4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butane dihydrochloride and 6.7 g of triethylamine are dissolved in 200 ml of methylene chloride. 2.28 g of ethyl chloroformate are added dropwise to this solution at room temperature and the reaction mixture is left to stand for one hour at room temperature, with stirring. The reaction mixture is concentrated under vacuum and the residue is taken up in ethyl acetate/water and washed successively with a 5% solution of sodium hydroxide, water and a saturated solution of sodium chloride. The organic phase is dried over Na₂SO₄ and concentrated under vacuum to give a residue, which is chromatographed on silica gel using a 94/6 methylene chloride/methanol mixture as the eluent. Concentration of the pure fractions gives a residue, which is taken up in ethyl acetate. A solution of hydrogen chloride in ether is added to the ethyl acetate solution and the hydrochloride is filtered off.

m=6.5 g
M.p.=108 DEG-110 DEG C.

EXAMPLE 98

N-Methyl-N-[4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichlorobenzamide hydrochloride
SR 46650 A a) 4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)-1-N-methylaminobutane hydrochloride

6.5 g of the product obtained in Example 97 and 1.6 g of lithium aluminum hydride are dissolved in 150 ml of tetrahydrofuran and refluxed for 3 hours. The reaction mixture is hydrolyzed by the addition of a 2N solution of sodium hydroxide and then filtered on Celite. The filtrate is concentrated under vacuum, the residue is taken up in ethyl acetate and the hydrochloride is obtained by the addition of a solution of hydrogen chloride in ether.

m=4.3 g
M.p.=234 DEG-236 DEG C.
b) SR 46650 A

SR 46650 A is obtained by reacting 2,4-dichlorobenzoyl chloride with the product obtained above, following the procedure described in Example 1.
M.p.=140 DEG-142 DEG C.

EXAMPLE 99

N-(1-Aminohexyl)-N-[4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl] -2,4-dichlorobenzamide dihydrochloride hemihydrate
 SR 46510 A a) 4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)-1-N-tritylaminopentylami dobutane

3 g of 1-amino-4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butane hydrochloride are suspended in 60 ml of methylene chloride in the presence of 3.2 ml of triethylamine. After the diamine has dissolved, 2.5 g of tritylaminocaproic acid and then 3.2 g of BOP are added. The reaction mixture is stirred at room temperature for 30 minutes, washed with water, a dilute solution of sodium hydroxide and then water, decanted, dried over MgSO₄, filtered and concentrated under vacuum. The residue is chromatographed on silica gel using a 95/5 methylene chloride/methanol mixture as the eluent. Concentration of the pure fractions gives 3.6 g of the expected product.

b) 4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)-1-N-(1-tritylaminohexyl) aminobutane

3.6 g of the product obtained above are dissolved in 40 ml of tetrahydrofuran and added dropwise to a suspension of 600 mg of lithium aluminum hydride in 20 ml of tetrahydrofuran. The reaction mixture is refluxed for 18 hours and then cooled, hydrolyzed, filtered and concentrated under vacuum. The residue is chromatographed on silica gel using an 80/20 methylene chloride/methanol mixture as the eluent. Concentration of the pure fractions gives 1.9 g of the expected product.

c) N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)-N-(1-tritylaminohexyl) aminobutyl]-2,4-dichlorobenzamide

1.9 g of the product obtained above are dissolved in 30 ml of methylene chloride. The solution is cooled to -20 DEG C. and 0.57 g of 2,4-dichlorobenzoyl chloride in 10 ml of methylene chloride is then added. The mixture is left to return to room temperature, washed twice with water, decanted, dried over MgSO₄ and concentrated under vacuum. The residue is chromatographed on silica gel using a 95/5 methylene chloride/methanol mixture as the eluent. Concentration of the pure fractions gives 1.5 g of the expected amide.

d) SR 46510 A

1.5 g of the tritylated derivative obtained above are dissolved in 15 ml of a 50% solution of formic acid in water and stirred at 60 DEG C. for one hour. The cooled mixture is filtered and the filtrate is concentrated under vacuum. The residue is taken up in water, washed with ether, rendered alkaline with sodium hydroxide, extracted with methylene chloride, decanted, dried over MgSO₄ and concentrated under vacuum. The residue obtained is taken up in 5 ml of methylene chloride, and a solution of hydrogen chloride in ether is added until the pH is 1.

m=1 g

M.p.=100 DEG C. (decomposition).

TABLE 4

Elemental analysis

CHN

Calculated %

SR n DEG Found %

Example n DEG

m B B' Z or M.p. DEGC. and Salt

47827 A (100)

2 3-Cl

4-Cl

60.706.375.05 60.736.754.93 HCl.H₂O

47852 A (101)

2 H 3-F

88 HCl

47239 A (102)

2 3-Cl

4-Cl

59.946.104.99 59.846.104.85 HCl.0.5 H₂O

47829 A (103)

2 3-Cl

4-Cl

59.946.104.99 59.836.304.77 HCl.0.5 H₂O

47241 A (104)

3 3-Cl

4-Cl

60.576.314.87 60.886.474.74 HCl.0.5 H₂O

47828 A (105)

2 3-Cl

4-Cl

64.926.545.04 64.596.774.88 HCl.0.5 H₂O

47240 A (106)

3 3-Cl

4-Cl

58.365.684.39 58.465.654.68 HCl.0.5 H₂

O

EXAMPLE 107

N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)-2-isobutylbutyl]-2,4-dichlorobenzamide hydrochloride
SR 46753 A a) 4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)-2-isobutylbutyronitrile

6 g of 4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyronitrile are dissolved in 70 ml of anhydrous ether in the presence of 0.62 g of sodium amide. The reaction mixture is refluxed for 2 hours and then left to return to room temperature and 2.12 g of 1-bromo-2-methylpropane are added. The reaction mixture is refluxed for 24 hours and concentrated under vacuum. The residue is taken up in water, extracted with ethyl acetate, decanted, dried over MgSO₄, filtered and concentrated under vacuum.

The expected product is obtained after purification by chromatography on silica gel using a 90/10 hexane/ethyl acetate mixture as the eluent.

b) 1-Amino-4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)-2-isobutylbutane

2.6 g of the product obtained above are dissolved in a mixture of 30 ml of ammonia and 20 ml of water. A catalytic amount of Raney nickel is added and hydrogenation is carried out at atmospheric pressure and at room temperature. The catalyst is filtered off and the filtrate is concentrated under vacuum. The residue is taken up in methanol and the hydrochloride is obtained by the addition of a solution of hydrogen chloride in ether.

c) SR 46753 A

SR 46753 A is obtained by reacting the product obtained above with 2,4-dichlorobenzoyl chloride, as described in Example 1.

M.p.=126 DEG C.

The compounds described in Table 5 were synthesized according to Example 107.

In the formula below, the group Ar' indicated in Formula I is a 3,4-dichlorophenyl group and the group Z is a 2,4-dichlorophenyl group.

TABLE 5

Product SR n DEG M.p., DEGC. Recryst.

(Example n DEG)

Q solvent. Salt

46507 A (108)
145-157 methylene chloride/ether 2HCl
46754 A (109)
124 pentane/ether 2HCl.H2 O
46566 A (110)
135-144 methylene chloride/ether 2HCl.H2

O

EXAMPLE 111

N-[4-(4-Benzoylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichloroben zamide hydrochloride
SR 46159 A a) 3-(3,4-Dichlorophenyl)-1-(tetrahydropyran-2-yloxy)-3-nitrilopropane

20 g of sodium hydride as a 55-60% dispersion in oil are suspended in 200 ml of dry tetrahydrofuran. A solution of 85 g of 3,4-dichlorophenylacetonitrile in 500 ml of tetrahydrofuran is added dropwise at 20 DEG C., in 30 minutes, and the reaction mixture is then stirred at room temperature for 2 hours. The mixture is cooled to -20 DEG C., a solution of 98 g of 1-bromo-2-tetrahydropyranoyloxythane in 100 ml of tetrahydrofuran is added, the mixture is left to return to room temperature and, after 2 hours, a solution of 50 g of ammonium chloride in 3 liters of water is added. The mixture is extracted with 1.5 liters of ether, washed with a saturated solution of sodium chloride, decanted, dried over MgSO4 and concentrated under vacuum.

The residue is chromatographed on silica gel using methylene chloride as the eluent. The pure product fractions are concentrated under vacuum to give 83.6 g of an oil.

b) 1-Amino-2-(3,4-dichlorophenyl)-4-(tetrahydropyran-2-yloxy)butane

83.6 g of the nitrile obtained above are dissolved in 100 ml of absolute ethanol. 350 ml of concentrated ammonia are added and Raney nickel (10% of the amount of starting amine) is then added while sweeping with nitrogen. Hydrogenation is then carried out under a hydrogen atmosphere at room temperature and ordinary pressure.

11.9 liters of hydrogen are absorbed in 3 hours. The catalyst is filtered off on Celite, the filtrate is concentrated under vacuum and the residue is taken up in a saturated solution of sodium chloride. 82.5 g of an oil are obtained after extraction with ether and drying over MgSO4.

c) 1-(2,4-Dichlorobenzoylamino)-2-(3,4-dichlorophenyl)-4-(tetrahydropyran-2-yloxy)butane

80 g of the amine obtained above are dissolved in 800 ml of methylene chloride. The solution is cooled to 0 DEG C. and 38.4 ml of triethylamine and then 55 g of 2,4-dichlorobenzoyl chloride are added. The reaction mixture is subsequently stirred at room temperature for one hour and then washed with water. The organic phase is decanted, dried over MgSO4 and concentrated under, vacuum to give 120 g of an oil.

d) 1-(2,4-Dichlorobenzoylamino)-2-(3,4-dichlorophenyl)butan-4-ol

120 g of the product obtained above are dissolved in 1 liter of methanol in the presence of 12 g of paratoluenesulfonic acid. The reaction mixture is stirred for 18 hours at room temperature and then concentrated under vacuum. The residue is taken up in methylene chloride and washed with a 10% solution of sodium carbonate. The organic phase is decanted and dried over MgSO4 to give 106 g of an oil.

e) 1-(2,4-Dichlorobenzoylamino)-2-(3,4-dichlorophenyl)-4-mesyloxybutane

106 g of the alcohol obtained above are dissolved in 1 l of methylene chloride, the solution is cooled to 0 DEG C. and 44 ml of triethylamine and 24.2 ml of mesyl chloride are then added. The reaction mixture is stirred at 0 DEG C. for 45 minutes, washed 3 times with iced water, decanted, dried over MgSO4 and concentrated under vacuum.

The residue is recrystallized from isopropyl ether.

m=95 g.

f) SR 46159 A

3 g of the mesylate obtained above and 3.1 g of 4-benzoylpiperidine are dissolved in 7 ml of methylene chloride and the reaction mixture is refluxed for 24 hours. The mixture is diluted in methylene chloride and washed with water, then with a dilute solution of sodium hydroxide and then again with water. The organic phase is decanted, dried over MgSO₄ and concentrated under vacuum. The residue is chromatographed on silica gel using a 70/30 methylene chloride/methanol mixture as the eluent.

The pure product fractions are concentrated under vacuum, the residue is diluted in methylene chloride and the hydrochloride is obtained by the addition of a solution of hydrogen chloride in ether.
m=930 mg.

The compounds of the Examples listed in Table 6 (I, Ar'=3,4-dichlorophenyl; Z=2,4-dichlorophenyl) were prepared according to Example 111.

The compounds of the Examples listed in Table 7 (I, Ar'=3,4-dichlorophenyl) and Table 8 (I, Ar'=3,4-dichlorophenyl or 3-trifluoromethylphenyl) were prepared according to Example 1, 2 or 3.

TABLE 6

(Example n DEG)Product SR n DEG
SaltFound %Calculated %CHNElemental

analysis		
47440 A (112)		
55.655.154.47	55.715.254.30	HCl
46416 A (113)		
58.164.884.67	58.365.004.49	HCl
46160 A (114)		
55.655.154.47	55.725.354.35	HCl.0.5 H ₂
O		
46508 A (115)		
54.274.554.37	54.504.614.22	HCl.0.5 H ₂
O		
46509 A (116)		
52.764.134.10	52.524.263.97	HCl
46619 A (117)		
51.845.277.32	51.725.537.09	HCl.0.5 H ₂
O		
46690 A (118)		
52.684.906.58	52.065.026.42	2HCl
47147 (119)		
53.824.686.72	53.614.726.46	HCl.0.5 H ₂
O		
47678 A (120)		
48.395.008.68	48.215.238.28	2HCl.H ₂ O
46261 A (121)		
52.684.914.55	52.915.014.47	HCl.0.5 H ₂
O		
46445 A (122)		
52.234.384.51	51.894.534.33	HCl.0.5 H ₂
O		
46158 A (123)		
55.474.974.46	55.574.974.43	HCl.0.5 H ₂
O		
46157 A (124)		
54.054.844.34	54.104.914.28	HCl.0.5 H ₂
O		
46511 A (125)		
53.874.524.19	53.694.754.05	HCl
46288 A (126)		
56.305.354.39	55.915.294.56	HCl.0.5 H ₂
O		

47348 A (127)
49.734.746.00 50.134.725.84 2HCl.H2O

O
TABLE 7

Elemental analysis

CHN

Calculated %

SR n DEG Found %

Example n DEG

TZ Salt

46924 A (128)
57.715.479.28 57.855.599.08 2HCl.0.5 H2O
46925 A (129)
57.715.479.28 57.805.419.21 2HCl.0.5 H2O
46913 A (130)
52.635.848.32 52.196.078.32 3HCl.H2O
46922 A (131)
50.615.318.43 51.015.458.21 2HCl.0.5 H2O
46915 A (132)
50.615.318.43 50.305.488.16 3HCl.0.5 H2O
46813 A (133)
58.905.838.54 58.626.018.42 3HCl.H2O

TABLE 8

Product SR n DEG M.p., DEGC. Recryst.
(Example n DEG)
m Ar' Z solvent. Salt

46721 A (134)

2

120-125 ether 2HCl

46827 A (135)

2 "

107-110 CH2 Cl2 /isopropyl
ether HCl

46890 A (136)

2 "

118-123 CH2 Cl2 /Et2 O

HCl

47099 A (137)

2 "

120-130 CH2 Cl2 /Et2 O

HCl

47157 A (138)

2

112 Pentane/Et2 O HCl

47221 A (139)

2

170-174 CH2 Cl2 /isopropyl
ether HCl

47284 A (140)

2 "

122 CH₂ Cl₂ /Et₂ O HCl
47437 A (141)
2 "
98-100 ether HCl
47806 A (142)
2 "
124 isopropyl ether/CH₂ Cl₂
HCl
47036 A (143)
2 "
159-161 AcOEt HCl
46769 A (144)
2 "
153-155 CH₂ Cl₂ /Ether HCl
47000 A (145)
2 "
200 AcOEt HCl
47580 A (146)
3 "
180 isopropyl ether HCl

EXAMPLE 147

N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichlorobenz amide (+) hydrochloride
SR 47050 A

The optical rotations of the compounds below were measured at 25 DEG C.

A) N-(1-Phenylethyl)-.beta.- (tert-butoxycarbonylaminomethyl)-3,4-dichlorobenz enepropionamide

Step 1

A solution of 39.6 ml of diisopropylamine in 200 ml of anhydrous THF is introduced into a 2-liter three-necked flask swept with nitrogen. The solution is cooled to -60 DEG C. and the following are added in order at this temperature:

176 ml of a 1.6M solution of butyllithium in hexane,
50 g of 3,4-dichlorobenzeneacetonitrile in 300 ml of THF, and then
39.4 ml of tert-butyl bromoacetate in 100 ml of THF.

The mixture is left to return to a temperature of 0 DEG C. in 2 hours 30 minutes. It is poured into 3 l of a saturated aqueous solution of ammonium chloride. The mixture is extracted twice with ether and dried over magnesium sulfate and the solvents are evaporated off. The oil obtained is chromatographed on 1 kg of silica H using a 95/5 cyclohexane/ethyl acetate mixture as the eluent. This gives 44.3 g of tert-butyl .beta.-cyano-3,4-dichlorobenzenepropionate.

M.p.=67 DEG C.

Step 2

A mixture of 40 g of the product obtained above (Step 1), 700 ml of absolute ethanol, 200 ml of concentrated ammonia (20%) and 3 spatulas of Raney nickel is stirred under a hydrogen atmosphere for 5 hours. After filtration of the catalyst and evaporation of the solvents, 38.8 g of tert-butyl .beta.-aminomethyl-3,4-dichlorobenzenepropionate are obtained in the form of an oil.

Step 3

A solution of 23.5 g of the product obtained above (Step 2) in 150 ml of methylene chloride is cooled to -10 DEG C. 250 ml of trifluoroacetic acid are added and the mixture is then left to return to a temperature of 20 DEG C. in 1 h 30 min.

After removal of the solvents, 27 g of .beta.-aminomethyl-3,4-dichlorobenzenepropionic acid trifluoroacetate are obtained in the form of an oil.

Step 4

150 ml of dioxane, then 30 ml of triethylamine and then a solution of 23 g of ditert-butyl dicarbonate in 50 ml of dioxane are added to a solution of 27 g of the product obtained above (Step 3) in 150 ml of water. The mixture is heated at 100 DEG C. for 1 hour. The dioxane is removed under vacuum and the solution obtained is washed with isopropyl ether. The aqueous phase is poured into 1.5 l of a phosphate buffer solution of pH 2. After extraction with ether and drying over magnesium sulfate, the solvents are evaporated off. The oil obtained is crystallized from isopropyl ether to give 20.3 g of .beta.- (tert-butoxycarbonylaminomethyl)-3,4-dichlorobenzene propionic acid.

Step 5

The following are added in order to a solution of 10 g of the product obtained above (Step 4) in 150 ml of methylene chloride:

- 8 ml of triethylamine,
- 3.5 g of S(-)-alpha.-methylbenzylamine, and
- 14 g of BOP (benzotriazolyl-N-oxytrisdimethylaminophosphonium hexafluorophosphate).

After stirring at room temperature for 1 hour, the mixture is washed with water, then with a phosphate buffer solution of pH 2 and then with a saturated aqueous solution of sodium bicarbonate. It is dried over magnesium sulfate and the solvents are removed under vacuum to give 12 g of N-(1-phenylethyl)-.beta.- (tert-butoxycarbonylaminomethyl)-3,4-dichlorobenzene propionamide.

B) Methyl ester of .beta.- (2,4-dichlorobenzoylaminomethyl)-3,4-dichlorobenzene propionic acid (+)

Step 1

Separation of the diastereoisomers of N-(1-phenylethyl)-.beta.- (tert-butoxycarbonylaminomethyl)-3,4-dichlorobenzene propionamide

The crude product is a mixture of two diastereoisomers. They can be separated by thin layer chromatography. They are separated preparatively by means of chromatography on 400 g of silica H using an 80/20 toluene/ethyl acetate mixture as the eluent. The less polar isomer emerges first and 5.8 g thereof are collected.

M.p.=146 DEG-147 DEG C.

[a]D =-43.6 DEG (c=1 in chloroform).

Step 2

A solution of 5 g of the product obtained above in 10 ml of dioxane and 50 ml of 6N hydrochloric acid is refluxed overnight. After cooling, the solution is washed with ether and the aqueous phase is then progressively neutralized with solid sodium bicarbonate until the pH is 7. This gives a precipitate, which is filtered off and washed with water, isopropanol and then ether. After drying, 1.88 g of .beta.-aminomethyl-3,4-dichlorobenzene propionic acid are obtained.

M.p.=202 DEG-204 DEG C.

Step 3

1.10 ml of thionyl chloride are added to a suspension of 1.85 g of the product obtained above (Step 2) in 20 ml of methanol, cooled to -20 DEG C. and under nitrogen, and the mixture is then left to return to a temperature of 20 DEG C. 2 hours later, 200 ml of ether are added and the product which has crystallized is filtered off and washed with ether. After drying, 2.15 g of methyl .beta.-aminomethyl-3,4-dichlorobenzene propionate (-) are obtained.

M.p.=184 DEG-186 DEG C.

[a]D =-4.3 DEG (c=1 in methanol).

Step 4

A solution of 2,4-dichlorobenzoyl chloride (1.54 g) in 5 ml of methylene chloride is added to a solution of 2.0 g of the product obtained above (Step 3) and 1.5 g of triethylamine in 20 ml of methylene chloride, cooled to 0 DEG C. 5 min later, the solution is concentrated to dryness, water is added and extraction is

carried out with ethyl acetate. The residue obtained is then crystallized from isopropyl ether to give 2.72 g of methyl .beta.-.(2,4-dichlorobenzoylaminoethyl)benzenepropionate (+).
M.p.=105 DEG-107 DEG C.

[.alpha.]D =+26.6 DEG (c=1 in chloroform).

C) Methyl ester of .beta.-.(2,4-dichlorobenzoylaminomethyl)-3,4-dichlorobenzenepropionic acid (-)

Step 1

Following the procedure described in Example 1 B), Step 1, the more polar isomer is collected using an 80/20 and then 60/40 toluene/ethyl acetate mixture as the eluent. Concentration of the fractions gives 5.4 g of N-(1-phenylethyl)-.beta.-.(tert-butoxycarbonylaminomethyl)-3,4-dichlorobenz enepropionamide.
M.p.=161 DEG-162 DEG C.
[.alpha.]D =-18.4 DEG (c=1 in chloroform).

Step 2

.beta.-Aminomethyl-3,4-dichlorobenzenepropionic acid is prepared following the procedure described in Example 1 B), Step 2.
M.p.=202 DEG-204 DEG C.

Step 3

Methyl .beta.-aminomethyl-3,4-dichlorobenzenepropionate (+) is prepared following the procedure described in Example 1 B), Step 3.
M.p. 184 DEG-185 DEG C.
[.alpha.]D =+3.9 DEG (c=1 in methanol).

Step 4

Methyl .beta.-.(2,4-dichlorobenzoylaminomethyl)-3,4-dichlorobenzenepropionate (-) is prepared following the procedure described in Example 1 B), Step 4.
M.p.=108 DEG-109 DEG C.

[.alpha.]D =-27.7 DEG (c=1 in chloroform).

D) Reduction of the methyl esters of .beta.-.(2,4-dichlorobenzoylaminomethyl)-3,4-dichlorobenzenepropionic acid (+) or (-)

First of all, a 0.5M solution of calcium borohydride in THF is prepared by stirring a suspension of sodium borohydride (0.1 mol) and calcium chloride (0.05 mol) in 100 ml of THF for 3 hours. 13 ml of this solution are then added to a solution of 2.5 g of the methyl ester of .beta.-.(2,4-dichlorobenzoylaminomethyl)-3,4-dichlorobenzenepropionic acid (+) or (-) in 20 ml of THF. The mixture is stirred overnight. The next day, the solution is cooled to 0 DEG C. and subsequently hydrolyzed with water and then dilute hydrochloric acid. After extraction with ether, the practically pure alcohol (+) or (-) is collected in the form of an oil.
E) Preparation of the mesylate (methanesulfonate) derivatives of .gamma.-.(2,4-dichlorobenzoylaminomethyl)-3,4-dichlorobenzenepropanol (+) or (-).

1.3 g of the alcohol obtained above are dissolved in 30 ml of methylene chloride, the solution is cooled to 0 DEG C. and 0.5 ml of triethylamine and 0.3 ml of mesyl chloride are then added. The reaction mixture is stirred at 0 DEG C. for 45 minutes, washed 3 times with iced water, decanted, dried over MgSO₄ and concentrated under vacuum.

The residue is chromatographed on silica gel using a 60/40 ethyl acetate/pentane mixture as the eluent. The pure fractions are concentrated under vacuum.

Thus, starting from the ester (+), a residue is obtained which is recrystallized from isopropyl ether to give 1.1 g of .gamma.-.(2,4-dichlorobenzoylaminomethyl)-3,4-dichlorobenzenopropanol (+) methanesulfonate.
M.p.=74 DEG-77 DEG C.

[.alpha.]D =+21.2 DEG (c=1 in chloroform).

Thus, starting from the ester (-), .gamma.-.(2,4-dichlorobenzoylaminomethyl)-3,4-dichlorobenzenopropanol

(-) methanesulfonate is obtained following the above procedure.
M.p.=72 DEG-76 DEG C.

[.alpha.]D =-22.5 DEG (c=1 in chloroform).

F) Preparation of N-[4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichlorobenz amide (+) hydrochloride.

SR 47050 A

0.6 g of the mesylate (+) obtained above and 0.54 g of 4-benzylpiperidine are dissolved in 1 ml of dimethylformamide and the reaction mixture is heated at 60 DEG C. for 30 minutes. Water is added and extraction is carried out with ethyl acetate. The organic phase is concentrated under vacuum and the residue is chromatographed on silica gel using a 97/3 methylene chloride/methanol mixture as the eluent.

The pure product fractions are concentrated under vacuum, the residue is diluted in methylene chloride and the hydrochloride is obtained by the addition of a solution of hydrogen chloride in ether.
m=0.5 g

[.alpha.]D =+14.0 DEG (c=1 in chloroform).

EXAMPLE 148

N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichlorobenz amide hydrochloride
SR 47051 A

SR 47051 A is obtained following the same procedure as above (according to Example 147 F)), except that the mesylate isomer (-) is used as the starting material.

[.alpha.]D =-14.5 DEG (c=1 in chloroform).

EXAMPLE 149

The compound below is prepared following the procedure described in Example 147 above:
N-[4-(4-benzylpiperidin-1-yl)-2-(3,4-difluorophenyl)butyl]-2,4-dichlorobenz amide (-) hydrochloride.
SR 47243 A [.alpha.]D =-8.5 DEG (c=1 in chloroform).

EXAMPLE 150

The compound below is prepared following the procedure described in Example 147 above:
N-[4-(4-benzylpiperidin-1-yl)-2-(3,4-difluorophenyl)butyl]-2,4-dichlorobenz amide (+) hydrochloride.
SR 47238 A [.alpha.]D =+7.3 DEG (c 1 in chloroform).

EXAMPLE 151

N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-4-fluoronaphthalene-1-carboxamide (+) and (-) hydrochloride

Step 1

1-Amino-2-(3,4-dichlorophenyl)-4-hydroxybutane

150 ml of a saturated solution of hydrogen chloride in ether are added to a solution of 149 g of 4-(tetrahydropyran-2-yloxy)-2-(3,4-dichlorophenyl)-1-aminobutane in 700 ml of methanol. The mixture is stirred for 1/2 hour at room temperature and concentrated under vacuum and the residue is taken up in 500 ml of water and washed with ether. The aqueous phase is rendered alkaline with a solution of sodium hydroxide and extracted twice with methylene chloride. The organic phases are dried over MgSO₄, filtered and concentrated under vacuum. The residue is taken up in 400 ml of isopropyl ether and the mixture is stirred for one hour at room temperature. The precipitate is filtered off and washed with ether.
m=98.2 g

M.p.=90 DEG-91 DEG C.

Step 2

(+)-Enantiomer of 1-amino-2-(3,4-dichlorophenyl)-4-hydroxybutane

A solution of 93 g of the racemate, previously prepared according to Step 1, in 300 ml of methanol is added to a refluxing solution of 59.65 g of D(-)-tartaric acid in 2 liters of methanol. The mixture is left to return to room temperature and the crystals are filtered off, washed with methanol and dried under vacuum at 50 DEG C. over P2 O 5.

m=64.8 g

[\alpha]D =-5.2 DEG (c=1 in water).

The product is then recrystallized from 2.96 l of methanol and the crystals are filtered off, washed with methanol and dried under vacuum at 50 DEG C. over P2 O 5.

m=45.3 g

[\alpha]D =-4.5 DEG (c=1 in water)

M.p.=201 DEG C.

The D(-)-tartrate is taken up in 250 ml of water, rendered alkaline with a concentrated solution of sodium hydroxide, extracted with 3 times 200 ml of methylene chloride, washed with a saturated solution of sodium chloride, decanted, dried over MgSO₄, filtered and concentrated under vacuum. The residue is taken up in isopropyl ether, the mixture is stirred for one hour at room temperature and the crystals are filtered off and washed with isopropyl ether.

m=24.7 g

[\alpha]D =+9.0 DEG (c 1 in methanol)

M.p.=79 DEG-80 DEG C.

(-)-Enantiomer of 1-amino-2-(3,4-dichlorophenyl)-4-hydroxybutane

The (-)-enantiomer is obtained following the above procedure and using L(+)-tartaric acid.

[\alpha]D =-9.2 DEG (c=1 in methanol)

M.p.=79 DEG-80 DEG C.

Step 3**N-[2-(3,4-Dichlorophenyl)-4-mesyloxybutyl]-4-fluoronaphthalene-1-carboxamid e ((-)-enantiomer)**

A solution of 4.45 g of 4-fluoronaphthoyl chloride in 50 ml of methylene chloride is added dropwise at -60 DEG C. to a solution of 5 g of the product obtained above ((+)-enantiomer) in 100 ml of methylene chloride in the presence of 2.6 g of triethylamine. The mixture is stirred for 15 minutes at -60 DEG C. and left to return to a temperature of -30 C. 2.5 g of triethylamine and 2.7 g of mesyl chloride are then added and the mixture is left to return to room temperature. It is washed with water and the organic phase is dried over MgSO₄ and concentrated under vacuum. The residue is chromatographed on silica gel using a 99.5/0.5 methylene chloride/methanol mixture as the eluent.

The pure fractions are concentrated under vacuum.

m=8.4 g

[\alpha]D =-22.8 DEG (c=1 in methanol).

N-[2-(3,4-Dichlorophenyl)-4-mesyloxybutyl]-4-fluoronaphthalene-1-carboxamid e ((+)-enantiomer)

The (+)-enantiomer is obtained following the procedure described above in Step 3, except that the (-)-enantiomer of Step 2 is used.

[\alpha]D =+22.7 DEG (c=1 in methanol).

Step 4**N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-4-fluoronaphthalene-1-carboxamide hydrochloride. (-)-Enantiomer. SR 48225 A**

7 g of the (-)-enantiomer obtained in Step 3 and 5.02 g of 4-benzylpiperidine are dissolved in 15 ml of dimethylformamide and the reaction mixture is heated at 70 DEG C. for two hours. The mixture is poured

into water and extracted with ethyl acetate and the organic phases are washed with a saturated solution of sodium chloride, dried over MgSO₄ and concentrated under vacuum. The residue is chromatographed on silica gel using a 97/3 methylene chloride/methanol mixture as the eluent.

The pure product fractions are concentrated under vacuum, the residue is diluted in methylene chloride and the hydrochloride is obtained by the addition of a solution of hydrogen chloride in ether.
m=6.2 g

[.alpha.]D =-35.5 DEG (c=1 in methanol).
(+)-Enantiomer. SR 48226 A

The (+)-enantiomer is obtained following the same procedure as for the (-)-enantiomer prepared above, except that the (+)-enantiomer obtained in Step 3 is used.
m=7 g

[.alpha.]D =+36.0 DEG (c=1 in methanol).

EXAMPLE 151

N-methyl-N [4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]phenylacetamide hydrochloride
SR 48172A.

The 4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)-1-methyl amino butane hydrochloride obtained in step a) of example 98 is treated with phenylacetic chloride according to the process of example 1, to obtain the compound SR 48172A.

Claims

What is claimed is:

1. A compound of the formula in which: m is 2 or 3; Ar and Ar' independently are a thienyl group; a phenyl group which is unsubstituted or mono- or disubstituted by a halogen atom, by a C1 -C3 alkyl, by a trifluoromethyl, by an alkoxy in which the alkyl is C1 -C3 by a hydroxyl or by a methylenedioxy; or an imidazolyl group; it also being possible for Ar' to be a benzothienyl group which is unsubstituted or substituted by a halogen; a naphthyl group which is unsubstituted or substituted by a halogen; a biphenyl group; or an indolyl which is unsubstituted or substituted on the nitrogen by a benzyl group; X is hydrogen; X' is hydrogen or a hydroxyl group or is joined to X" below to form a carbon-carbon bond, or X and X' together form an oxo group or a dialkylaminoalkoxyimino group of the formula .dbd.N--O--(CH2)p --Am, in which p is 2 or 3 and Am is a dialkylamino group, it being possible for each alkyl to contain from 1 to 4 carbon atoms; Y is a nitrogen atom or a group C(X"), in which X" is hydrogen or forms a carbon-carbon bond with X'; Q is hydrogen, a C1 -C4 alkyl group or an aminoalkyl group of the formula --(CH2)q --Am', in which q is 2 or 3 and Am' is a piperidino, 4-benzylpiperidino or dialkylamino group, it being possible for each alkyl to contain from 1 to 4 carbon atoms; R is hydrogen, a methyl group or a group (CH2)n --L, in which n is an integer from 2 to 6 and L is hydrogen or an amino group; T is a group selected from W being an oxygen or sulfur atom; and Z is either hydrogen, or M or OM when T is the group --C(.dbd.O)--, or M when T is the group --C(.dbd.W)--NH--, M being hydrogen; a linear or branched C1 -C6 alkyl; a phenylalkyl in which the alkyl group contains from 1 to 3 carbon atoms and which is unsubstituted or mono- or poly-substituted on the aromatic ring by a halogen, a hydroxyl, an alkoxy having 1 to 4 carbon atoms or an alkyl having 1 to 4 carbon atoms; a pyridylalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a naphthylalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a pyridylthioalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a styryl; a 1-methylimidazol-2-ylthioalkyl in which the alkyl group contains from 1 to 3 carbon atoms; a 1-oxophenyl-3-indan-2-yl; or an unsubstituted or mono- or poly-substituted aromatic or heteroaromatic group; or one of its salts with mineral or organic acids.
2. An optically pure compound according to claim 1 of the formula in which: "*" means that the carbon atom denoted by this symbol has a defined (+) or (-) absolute configuration; and m, Ar, Ar', X, X', Y, Q, R, T and M are as defined in claim 1; or one of its salts with mineral or organic acids.
3. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichlorobenzamide or one of its pharmaceutically acceptable salts; a compound according to claim 1.
4. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-difluorophenyl)butyl]-2,4-dichlorobenzamide or one of its pharmaceutically acceptable salts, a compound according to claim 1.
5. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-4-fluoronaphthalene-1-carboxamide or one of its pharmaceutically acceptable salts, a compound according to claim 1.
6. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichlorobenzamide (+) or one of its pharmaceutically acceptable salts, a compound according to claim 1.
7. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-2,4-dichlorobenzamide (-) or one of its pharmaceutically acceptable salts, a compound according to claim 1.
8. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-difluorophenyl)butyl]-2,4-dichlorobenzamide (+) or one of its pharmaceutically acceptable salts, a compound according to claim 1.
9. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-difluorophenyl)butyl]-2,4-dichlorobenzamide (-) or one of its pharmaceutically acceptable salts, a compound according to claim 1.
10. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-4-fluoronaphthalene-1-carboxamide (+) or one of its pharmaceutically acceptable salts, a compound according to claim 1.
11. N-[4-(4-Benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]-4-fluoronaphthalene-1-carboxamide (-) or one of its pharmaceutically acceptable salts, a compound according to claim 1.
12. A pharmaceutical composition containing, as the active principle, a compound of formula (I) according

to claim 1.

13. A pharmaceutical composition according to claim 12, in the form of a dosage unit, in which the active principle is mixed with at least one pharmaceutical excipient.

14. A composition according to claim 12, containing from 2.5 to 1000 mg of active principle.

15. N-methyl-N[4-(4-benzylpiperidin-1-yl)-2-(3,4-dichlorophenyl)butyl]phenylacetamide hydrochloride, a compound according to claim 1.

16. A pharmaceutical composition containing, as the active principle, a compound of formula (I*) according to claim 2.

17. A pharmaceutical composition according to claim 16 in the form of a dosage unit, in which the active principle is mixed with at least one pharmaceutical excipient.

18. A pharmaceutical composition according to claim 16, containing from 2.5 to 1000 mg of active principle.